Capturing Thinking on the Talk Frame

This instructional tool helps students engage in discussions that foster reasoning, then settle on correct mathematics.

By Tutita M. Casa

The National Council of Teachers of Mathematics (NCTM 1991, 2000) recommends that students be positioned as sense makers who weigh one another's ideas and judge their mathematical validity. Teachers may want to facilitate such discussions, but—

> the prospect of creating such a community is daunting to many teachers. They often do not know where to begin to create the discourse practices described by NCTM. (Hufferd-Ackles, Fuson, and Sherin 2004, p. 81)

Teachers who allow students to have a greater voice in the discussion find it more challenging to manage the direction of the talk, particularly when students voice misconceptions in their thinking. Anticipating how the discussion will unfold is a significant undertaking, as is guiding it toward mathematically valid ideas while valuing students' ways of thinking (Hufferd-Ackles, Fuson, and Sherin 2004; Staples 2007).

Given that many teachers find NCTM's recommendations challenging, I developed a talk frame as a practical teaching and learning aid that values students' evolving thoughts as teachers guide them toward correct mathematical conclusions. The talk frame displays an organized written record of a discussion. It captures students' rewording of a question addressing a significant topic, their evolving reasoning, and the mathematically valid conclusions. The teacher paraphrases and records student thinking and regularly checks with students to make sure that she writes accurate representations.

I first discuss the nature of tasks that would be appropriate to use with the talk frame. I then share a lesson using the talk frame and present a general overview of how to implement it.

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Planning to use a talk frame

The talk frame should be used with questions that focus on a significant mathematical concept; that require your students to reason; and that encourage debate about strategies, answers, and student misconceptions (Barlow and McCrory 2011). Teachers can draw on their knowledge of student thinking to identify areas that are problematic for many students, such as relying solely on the denominator to compare fractions or using a ruler to measure length starting at "1" without accounting for this in the final measure.

The Common Core State Standards for Mathematics (CCSSM) document (CCSSI 2010) recommends for grade 1 that students distinguish between defining and nondefining attributes of shapes, another challenging topic for students. The aim of my lesson was to move students beyond the van Hiele (1999) visual level. A student at this visual stage, for instance, would incorrectly define a chevron (see **fig. 1**) as a triangle because "it looks like one." Students at the descriptive level would recognize properties of this polygon (i.e., it has four sides) and identify it as a quadrilateral.

FIGURE 1

A student at the van Hiele visual level would incorrectly call a chevron a triangle. Casa wanted to use a talk frame to move students to the descriptive level, where they would recognize the polygon's properties.

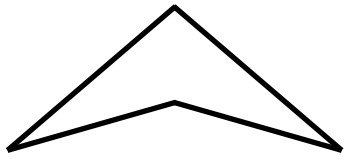


FIGURE 2

This class of first graders could specify that triangles have three sides and three vertices. Uncertain whether they knew that triangles are closed, simple, and have straight sides, Casa had them compare multiple representations.

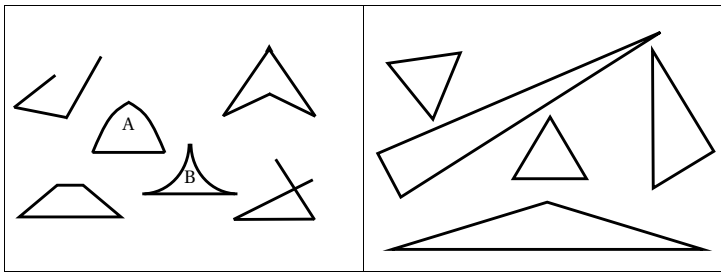
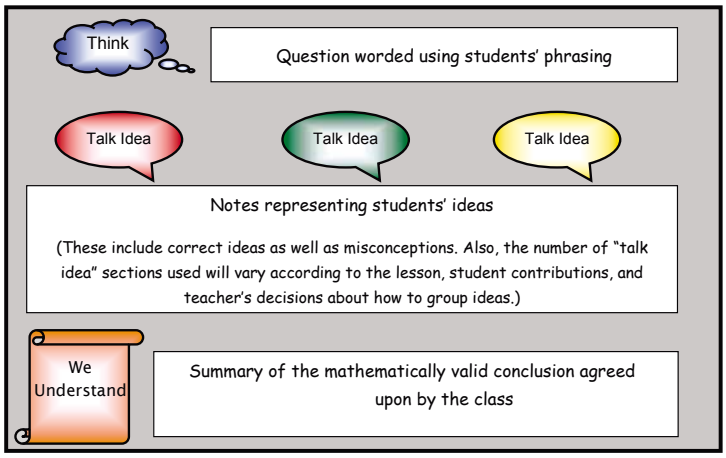


FIGURE 3

Talk frames are practical teaching and learning aids that capture students' evolving reasoning—by displaying a written record of a discussion in an organized manner—toward mathematically valid conclusions.



I had worked with a class of first graders to support a transition toward the descriptive level, and I felt fairly confident that they knew triangles have three sides and three vertices regardless of orientation or side lengths. Yet I was uncertain whether they knew that triangles are closed, simple, and have straight sides. Knowing that—

> young students naturally generalize from examples, [and] teachers should guide them to use examples and counterexamples to test whether their generalizations are appropriate (NCTM 2000, p. 122),

I gave them various incorrect and correct representations (see **fig. 2**) to allow them to compare and contrast figures.

Implementing a talk frame

A talk frame captures three portions of an evolving discussion (see **fig. 3**): Think, Talk Ideas, and We Understand. I share some dialogue and reflections concerning the talk frame as my lesson unfolded and then give readers a general overview describing how to implement each section.

Think section

In the Triangle lesson, I explained to the class that another class was confused about what defines a triangle. My initial goal was to get students to focus on my objectives and, if necessary, help them formulate an appropriate question. **Figure 4** depicts part of the discussion; I include my reflections to help readers understand some of the decisions I made in facilitating the discussion, which the talk frame supported.

The Think section addresses what twentieth-century science fiction writer Ursula LeGuin observed: "There are no right answers to wrong questions." Thus, this section encourages students to contemplate what is being asked before they solve the problem. This step serves to focus everyone on the topic and is analogous to a topic sentence. I have found this to be a critical step to help the class grapple more efficiently with my objectives. So that students can be confident the question makes sense, have them reword the question. After all, they are the ones who will solve the problem. Such prompts as the following can nudge students toward rewording the question in a way that captures its essence:

- What do they want to know?
- What should you explain?
- How would you ask this same question using your own words?

Talk Idea section

In the Triangle lesson, the class immediately and correctly identified the second set of figures as the one depicting triangles. When I asked why,

FIGURE 4

Casa's goal during the Think section of the Triangle lesson was to have students focus on what defines a triangle and, if necessary, help them formulate a suitable question.

Teacher: What do they want to know from you?

Aidan: The other students don't know what makes a triangle.

Alexa: I think they want to know, like, how to make a triangle and how many sides they have.

Teacher: So, it sounds like, What makes a triangle? [*Some students nod*.]

[*Casa reflects:* Neither student posed a question, so I offered a possible one.]

Alexa: I think they don't know how to make a triangle, like vertices. They want to know how.

[*Casa reflects:* Alexa understood what was being asked.]

Teacher: What do they want to know from you? Nadia?

[*Casa reflects:*I wanted to ensure that more students understood the question. Having the class hear it two or three times benefits everyone.]

Nadia: They have trouble.

Teacher: They have trouble with what?

Nadia: Counting the vertices.

Teacher: Counting the vertices of what?

Nadia: The triangles.

Teacher: The triangles. So, they don't know what a …

Daren: Triangle is!

Teacher: A triangle is. So, let's write this on the board. Tell me if you agree. "What is a triangle?" Is that what they want to know?

Class: Yes.

[*Casa reflects:* I waited for an OK from the class before writing so that they felt ownership over the question.]

FIGURE 5

The first talk idea for the Triangle lesson correctly identified the second set of figures as triangles and listed two attributes.

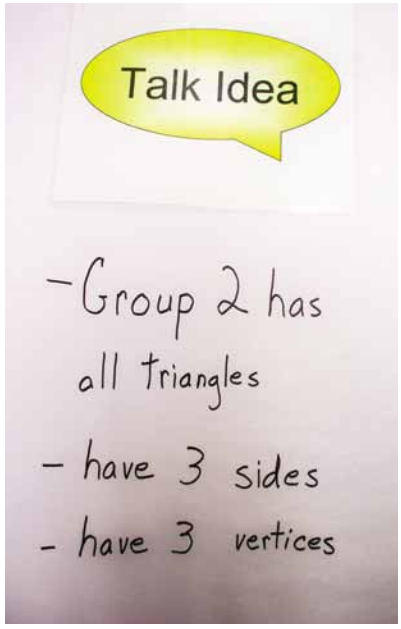


FIGURE 6

Casa repeated the triangle attributes one at a time to check if she had recorded Sheila's ideas accurately.

Teacher: "They have three corners." Is that what you said?

Students: Vertices!

Teacher: Oh, three vertices.

[*Casa reflects:* Although students had learned the definition of vertex, I intentionally used less sophisticated vocabulary to assess them and convey that my role was to capture their ideas accurately.]

Sheila responded, "Because it has three sides and three vertices" (see **fig. 5**). I then repeated her ideas, one at a time, and asked whether I had recorded them accurately (see **fig. 6**). I had overheard several students discussing the attributes of the figures in set 1, so I had them share

with the class. Alicia mentioned that a shape had four, not three, sides. This became the second Talk Idea (see **fig. 7**).

Aidan then offered, "It looks like there are some triangles inside the first [set]" [*pointing to* A *in* **fig. 2**]. I captured his incorrect concept under the third Talk Idea (see **fig. 8**), which created cognitive dissonance for some students. I wanted the class to consider the idea further, especially given our focus on an important attribute (see **fig. 9**).

The class agreed that the figure had three vertices, so I had students partner talk about whether it had one side. When we regrouped as a class, Aidan mentioned that he thought it had three sides (see **fig. 10**). He walked up to the talk frame to point out the parts of the figure.

Partners eventually settled on either one side or three sides. To be sensitive to students' feelings, I left the four-side comment up, to acknowledge that it was a thought they had considered. I did not pursue why they had changed their minds, because the reason was not integral to my objective. Several students

FIGURE 7

When Casa overheard a discussion about group 1 figure attributes, she had those students share with the entire class. This became the second talk idea.

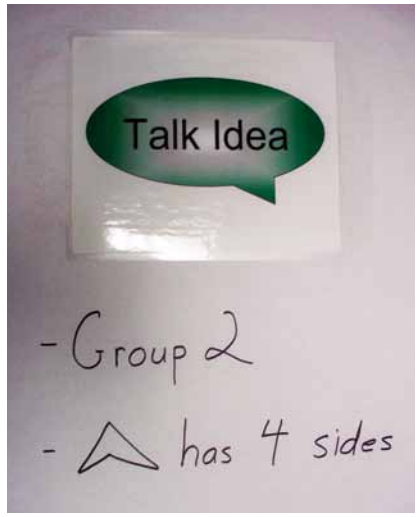
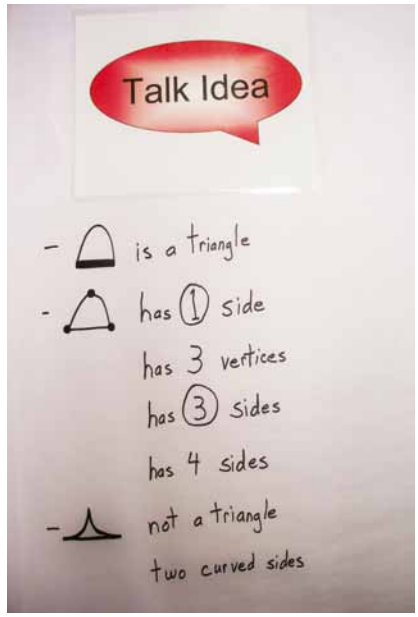


FIGURE 8

Under the third talk idea, Casa recorded a student's incorrect concept, which created dissonance for some class members.



Talk frame benefits

The talk frame has advantages for both the person instructing and those being instructed. Teachers who use the talk frame in the manner described in this article will find that it—

- helps focus the discussion on a significant mathematical topic;
- encourages concentration on and making sense of students' ideas;
- gives time to decide how to navigate the discussion;
- allows formative assessment of the class and individual students' depth of understanding; and
- assists in facilitating the process for the class to come to valid mathematical conclusions.

Talk frames support students in learning mathematics by—

- allowing them to see their thinking develop over time;
- encouraging them to rely on their own reasoning;
- conveying that their ideas are important and yet they can change;
- letting them realize that solving problems can result in multiple perspectives;
- having them see how different representations, such as drawings, can symbolize ideas;
- showcasing the appropriate use of math vocabulary; and
- reinforcing the eventual need for mathematical agreement.

defended their positions, but those who knew the figure was not a triangle were unable to convince others of this notion. Therefore, I brought in **figure B** (see  in **fig. 2**), a concave-type "triangle" that had the same characteristics as **figure A**, for us to talk about (see **fig. 11**).

In general, the Talk Idea section has the teacher paraphrase students' ideas. She should capture the ideas, not interpret or refine them. Students can literally see their ideas represented,

FIGURE 9

Because the number of sides is an important attribute of a triangle, Casa wanted the class to focus on the inaccurate part of the third Talk Idea.

Teacher: Is this [*pointing to* **shape A** *in* **fig. 2**: ] a triangle? Yes or no?
Class: Yes. No.
Teacher: What do you think, Brendon?
Brendon: I think it's not; because, if you look in the picture, it has three vertices [*pointing to each one*] but only one side.
Teacher: Three vertices and only one side. He said that there is only one side. So, let's get that idea down. So, this shape has one side. And this shape has three vertices. Is that what you said?
[*Casa reflects:* I drew the shape on the talk frame to make sure students focused on Brendon's idea instead of another shape.]

FIGURE 10

After the class agreed that **shape A** in **figure 2** has three vertices, students paired up to talk about whether it has one side. When the entire class regrouped, Aidan walked to the talk frame to point out why he thought **shape A** has three sides.

Aidan: I was noticing that this line is straight [*pointing to the side*], but then it curves there [*tracing the curved sides*].
Students: That's what I think. Me, too!
Aidan: It looks like it goes down; then it curves up.
Teacher: Aidan, is this what you mean? Because I don't know if everyone knows [*pointing to the figure on the talk frame*]. So, you're saying that this side is straight. But you said that this one is…?
[*Casa reflects:* I had Aidan stay next to the talk frame to acknowledge that the idea was his, not mine, and to answer questions.]
Aidan: Curved.
Teacher: So, you disagree that it has one side? [*Aidan nods*.] So, how many sides do you think this shape has?
Aidan: Well, I'm thinking that it might have three or four.
Teacher: So, you think this shape has three or four sides? [*Other students nod*.]
Teacher: OK [*turning to the class*], so what are your thoughts? How many sides? It has one side, has three sides, and it has four sides.
[*Casa reflects:* I pointed to phrases on the talk frame as I read them so students could both hear and see their ideas.]
Teacher: So, I want you to talk to your partner about which one it is.

FIGURE 11

When those who thought that **shape B** in **figure 2** is not a triangle were unable to convince others, Casa presented a shape with concave sides.

Teacher: You know, I noticed another shape up here. I noticed the same thing. Does this [*pointing to* **shape B**: ] look the same?
[*Casa reflects:* Drawing a representation of the original shape on the talk frame made it prominent.]
Students: Curved again! It's curved.
Aidan: I don't think that's a triangle.
Teacher: So you don't think this one is a triangle? Why don't you think so?
Students: No, it is not.
It looks like a triangle to me.
It is, but it has curved sides.
Teacher: So there's some disagreement. Let's go ahead and talk to your partners again. What do you think? Is it a triangle, or isn't it?
[*Casa reflects:* Partners referenced the talk frame, which is something they do regularly.]

FIGURE 12

The We Understand section is essential because it allows students to see the correct math, to hear it, to recognize that established mathematical truths exist, and also to solidify their previous knowledge.

Teacher: I heard someone say that we're ready for the We Understand. So, what can we say about what is a triangle? What's one thing that you now understand?

[*Casa reflects:* Reverting back to the Think section continues to convey that these discussions are centered on a significant idea.]

Kayleen: It has to have three straight sides.

Teacher: [*writing* "-has 3 straight sides"]

[*Casa reflects:* They added "straight" to their original idea.]

Teacher: OK, what else makes it a triangle?

Leila: They have to have three vertices.

Teacher: They have three vertices [*adding* "-has 3 vertices"].

and they are encouraged to consider their ideas among those of their classmates. Several features of this section of the lesson are crucial for encouraging students to take ownership of their thoughts and to rely on valid mathematical evidence:

1. List Talk Ideas horizontally so that students do not infer that one idea is better than another.
2. As you record students' ideas, confirm with students that the notes accurately represent their ideas; revise them as necessary.
3. Represent both correct and incorrect student ideas. This concept may be disconcerting to some teachers who may reason that if they record misconceptions, then students will not learn the right concept. Instead, students consider all perspectives offered rather than relying on the teacher to indicate—subtly or directly—whether those ideas are right or wrong. I contend that students who truly do not understand a concept and change their minds after seeing an incorrect idea have a tenuous understanding of it and need further instruction. Also, discussing why an idea is incorrect often helps some students gain a richer understanding of the correct concept than they otherwise would have (Barlow and McCrory 2011). Moreover,

> such communication about mathematical thinking can help everyone in the classroom understand a given concept or method because it elucidates contrasting approaches, some of which are wrong—but often for interesting reasons. (Fuson, Kalchman, and Bransford 2005, p. 228)

The correct mathematics is recorded somewhere in the Talk Idea section as well as represented in the final component of the talk frame.

We Understand section

The class began to realize that **figures A** and **B** (see **fig. 2**) are not triangles, because the sides of a triangle cannot be curved. I then had them refer to the first Talk Idea and label the sets as *triangles* and *not triangles*. I overheard Lenny say, "Now we understand!" I felt confident that the class had come to realize that triangles must have straight sides (see **fig. 12**).

Although representing all student thoughts on the Talk Idea sections is important, students must recognize that established mathematical truths exist. The We Understand component captures such truths. This section is completed after the teacher assesses that the class understands the concept. Students share their correct ideas, and the teacher paraphrases them on the board. The We Understand section is significant because it allows students to see and hear the correct mathematics and also to solidify their previous knowledge.

Students can see their own development

Experiences with the talk frame will differ across grade levels and with different content. For instance, these young students needed support rewording the question even though they were accustomed to using a talk frame. Older students can reword questions independently; all students will become increasingly proficient with practice. The wording of the question also will differ. For

example, What's true about all triangles? has the same aim as our question, What is a triangle? Not surprisingly, the sophistication of the contributions also will increase as students further develop their reasoning abilities and as the questions become more complex. Although many students do not reach the descriptive level of understanding of shapes until the middle school years (Clements 2003), these first-grade students were able to move forward in their understanding by reaffirming previous knowledge as they accommodated an additional property of polygons, mainly that the sides must be straight.

Overall, the talk frame has supported my teaching and students' learning of math in multiple ways (see the **sidebar** on **p. 520**). It has helped me focus on my students' thinking and allowed them to play a significant role in our discussions. Over time, they come to see their developing reasoning represented on the talk frame as an integral part of their study of mathematics.

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The talk frame technique aids student discourse.

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